An Ultracompact Opto-Electro-Fluidic System for Preconcentration and Separation of Chiral Molecules in *In Situ* Life Detection

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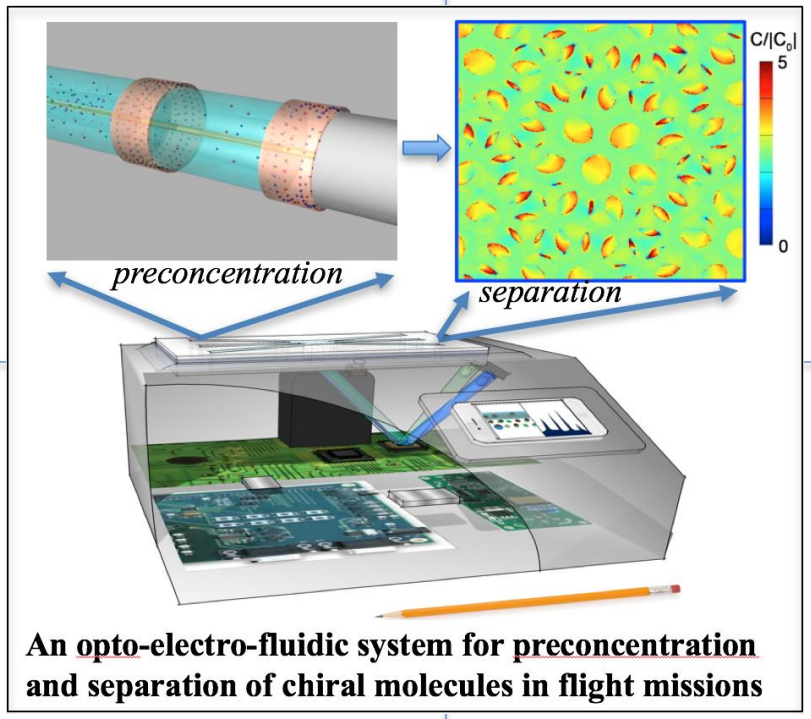
Research Objectives

- Develop an opto-electro-fluidic system that can efficiently preconcentrate and separate low-abundance chiral molecules from large quantities of fluids for *in situ* life detection.
- To explores working principles of innovative preconcentration and separation of chiral molecules under variable gravity fields.
- The project will start as TRL1 (to study principles for thermophoretic concentration and optical separation of chiral molecules) and end as TRL3 (to prototype an integrated opto-electro-fluidic system).



An opto-electro-fluidic system for preconcentration and separation of chiral molecules in flight missions

Approach

- Exploit thermophoresis and electrothermal flow in tubes to preconcentrate low-abundance molecules with both positive and negative Soret coefficients.
- Exploit metamaterial-enhanced chiral gradient force for label-free enantioselective separation of chiral molecules in microfluidic channels.
- Integrate preconcentration and separation components into a single ultracompact system and test its performances.

Potential Impacts

- Enhance *in situ* life detection for determining whether other habitable environments and even life itself can be found outside of Earth.
- Enable the miniature end-to-end *in situ* instruments in flight missions.
- Benefit drug screening, drug purification, and point-of-care biomedical applications in human space exploration.